



Capacity Mechanisms: management of Interconnectors and cross-border effects

David Newbery

University of Cambridge

Cambridge Spring Research Seminar

16th May 2014

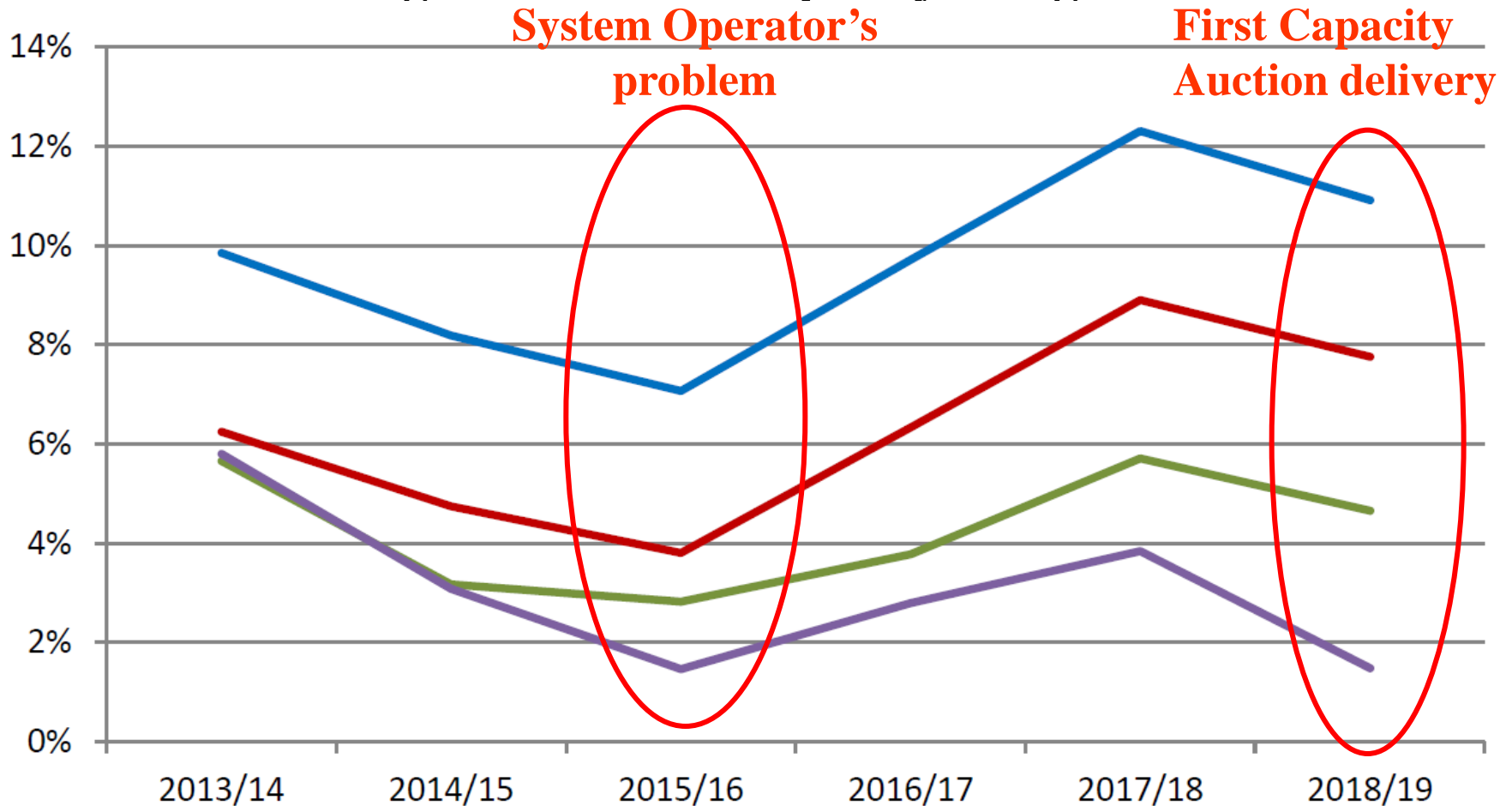
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Outline

- What is the problem?
- Energy-only markets and capacity payments: theory
 - policy failures, price caps
- Proposed EMR capacity auction
 - defended by missing money ($VOLL > \text{max energy price}$)
 - complications: risk, market coupling rules
- Interconnectors: problems

What is the problem?

Ofgem's derated capacity margin



Source: DECC IA

- Reference Scenario 2013
- Low Supply
- High Demand
- Conventional Generation High Availability

Interconnectors by 2018

IFA	to France	2 GW
Britned	to NL	1 GW
Moyle	to NI	0.5 GW (or 0.25?)
EWIC	to RoI	0.5 GW
<i>NEMO</i>	<i>to Belgium</i>	<i>1 GW</i>
<u><i>Eclink</i></u>	<i>to France</i>	<u><i>1 GW</i></u>
Total		6 GW

- potential swing 12 GW = 20% peak demand
- emergency SO actions cannot reverse IC flow

Key question - what contribution to derated capacity?

Poyry (2012): 50-80% depending on margins abroad

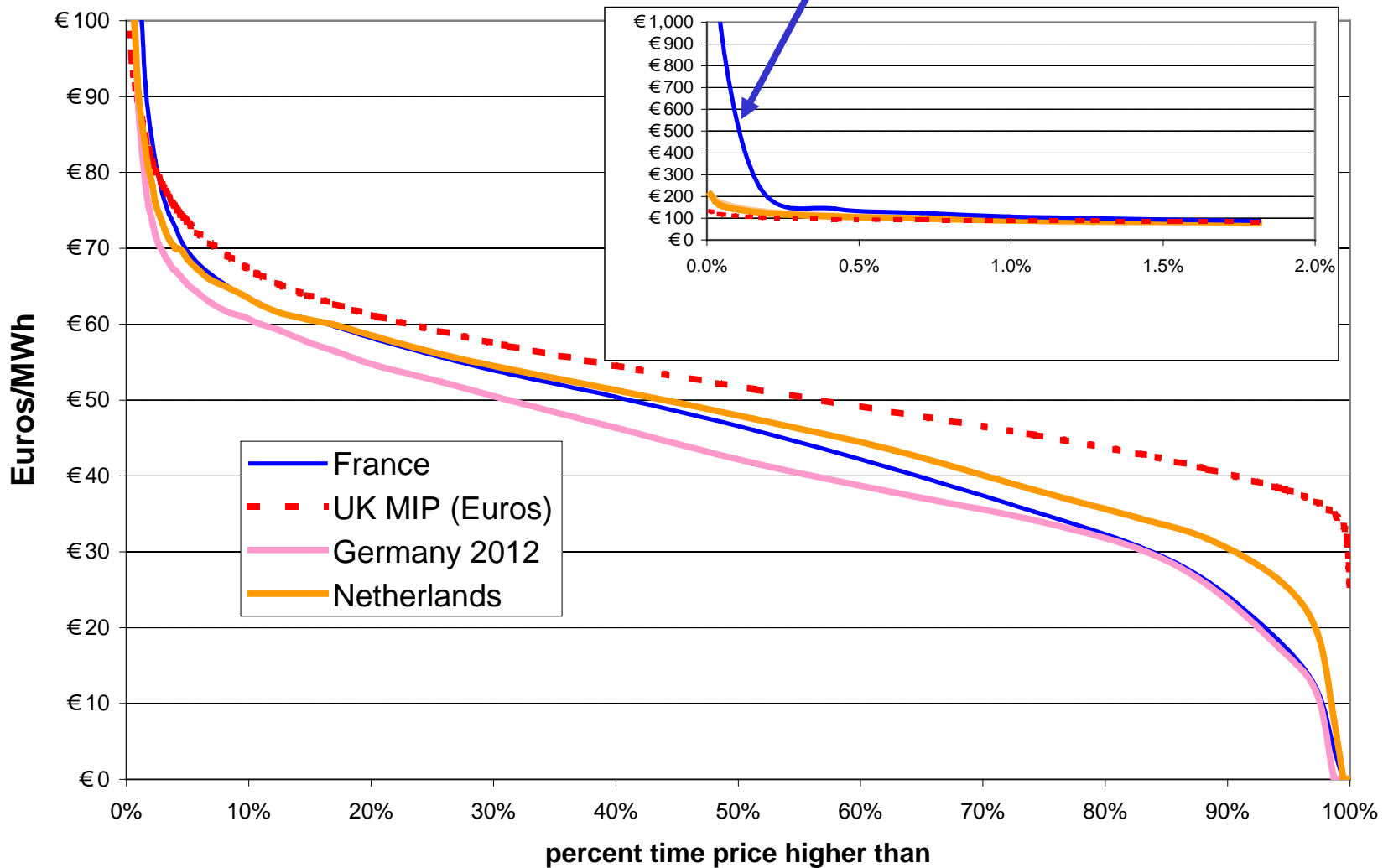
- If generators can (and are allowed to) bid scarcity prices no problem?
 - France (*de facto* monopoly) bids high peak prices
 - GB has adequate capacity and flat prices
- Wind, PV, cheap coal, low C prices drive clean spark spreads negative (in DE especially)
 - electricity prices affected by policy

=> policy uncertainty undermines peaking investments needed

Capacity contracts to address policy failure

France much peakier than GB

European power exchanges 2012



Capacity payments: theory

$$\text{Efficient price} = \text{SMC} + \text{CP}$$

SMC = system marginal cost, CP = capacity payment

$$\text{CP} = \text{LoLP} * (\text{VoLL} - \text{SMC})$$

LoLP = Loss of Load Probability in each hour

LOLE =  LoLP over year (Loss of Load Expectation)

set at 3 hrs in GB

=> VoLL = Value of Lost Load = £17,000/MWh

- Max price in **Euphemia** day-ahead = €3,000/MWh
 - Max price in France = €3,000/MWh
 - Max price in SEM (Ireland) = €1,000/MWh

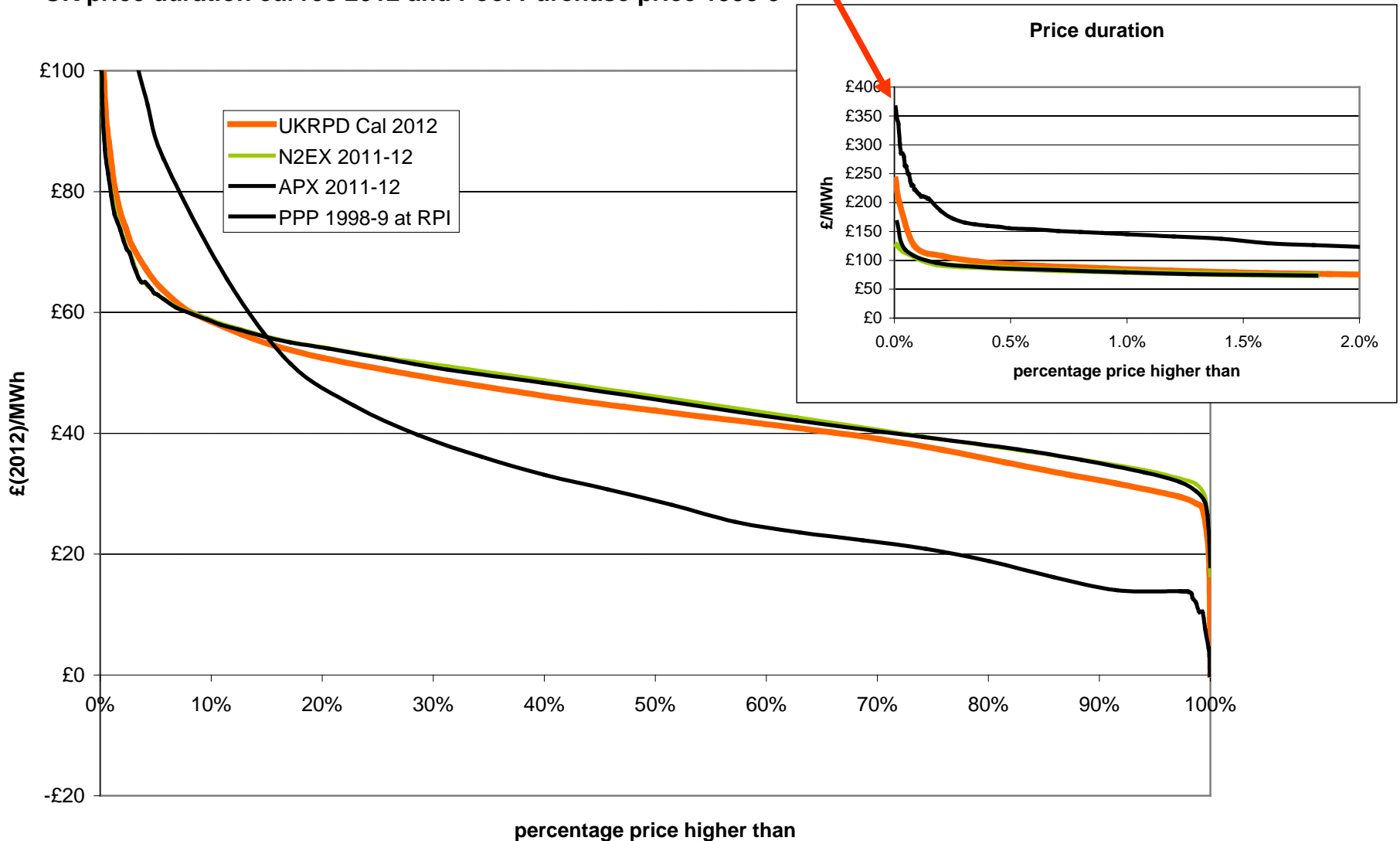
Experience in the Pool and BETTA

- The Pool (1990-2001) had an explicit CP at $LoLP^*(VoLL-SMP)$, $VoLL = \text{£}(2013)5,000/\text{MWh}$
 - (but **SMP** is as bid, not **SMC**)
- NETA/BETTA was an **energy-only** market with a **Balancing Mechanism**, System Buy and Sell prices
 - reformed many times, long side defaults to prompt price
 - initially pay-as-bid, then average of last N MW
 - consulting on Significant Code Review to deal with 2015/16

How well did they signal scarcity?

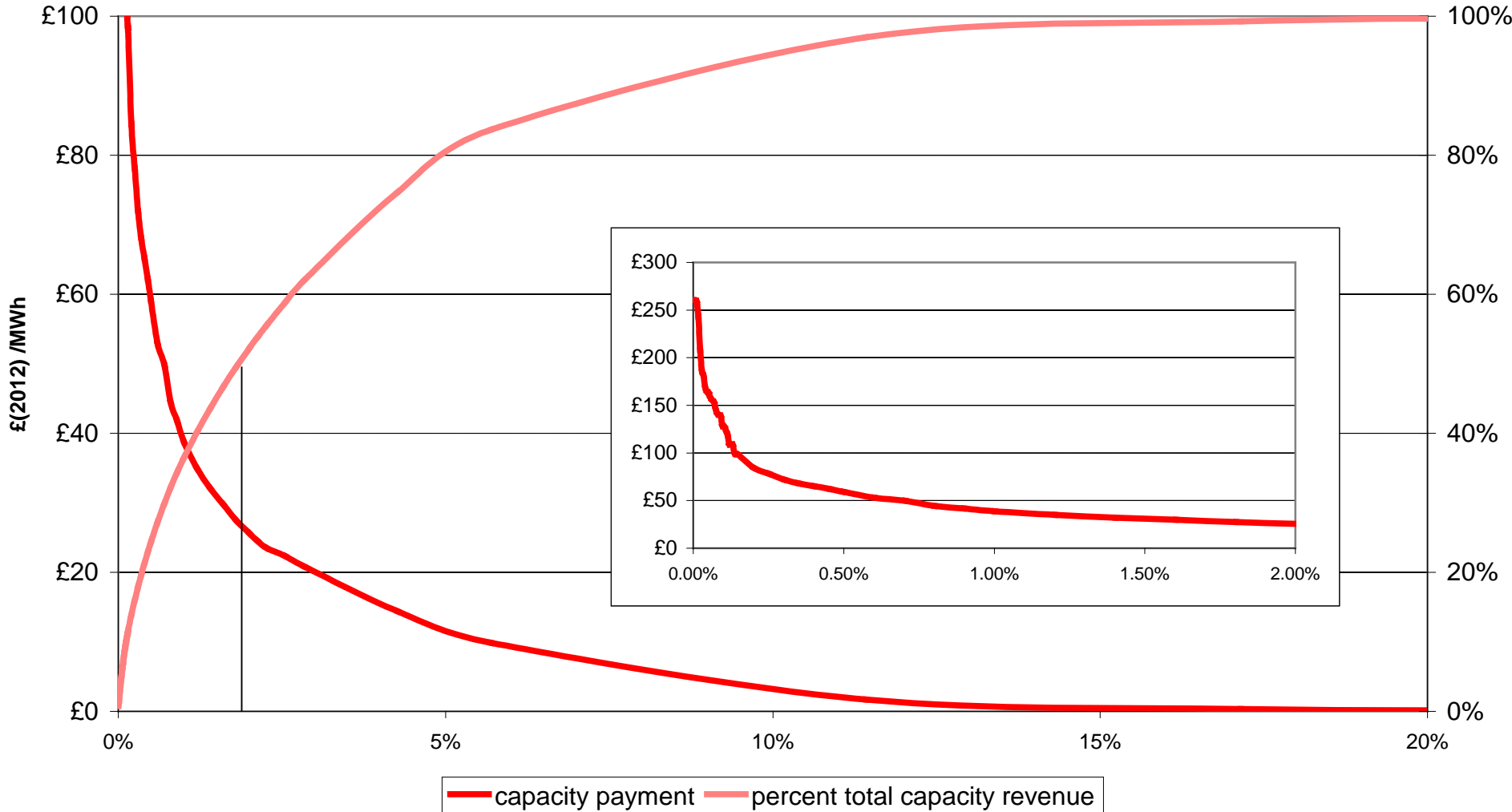
Pool prices were peakier than spot market as they had a capacity payment

UK price duration curves 2012 and Pool Purchase price 1988-9



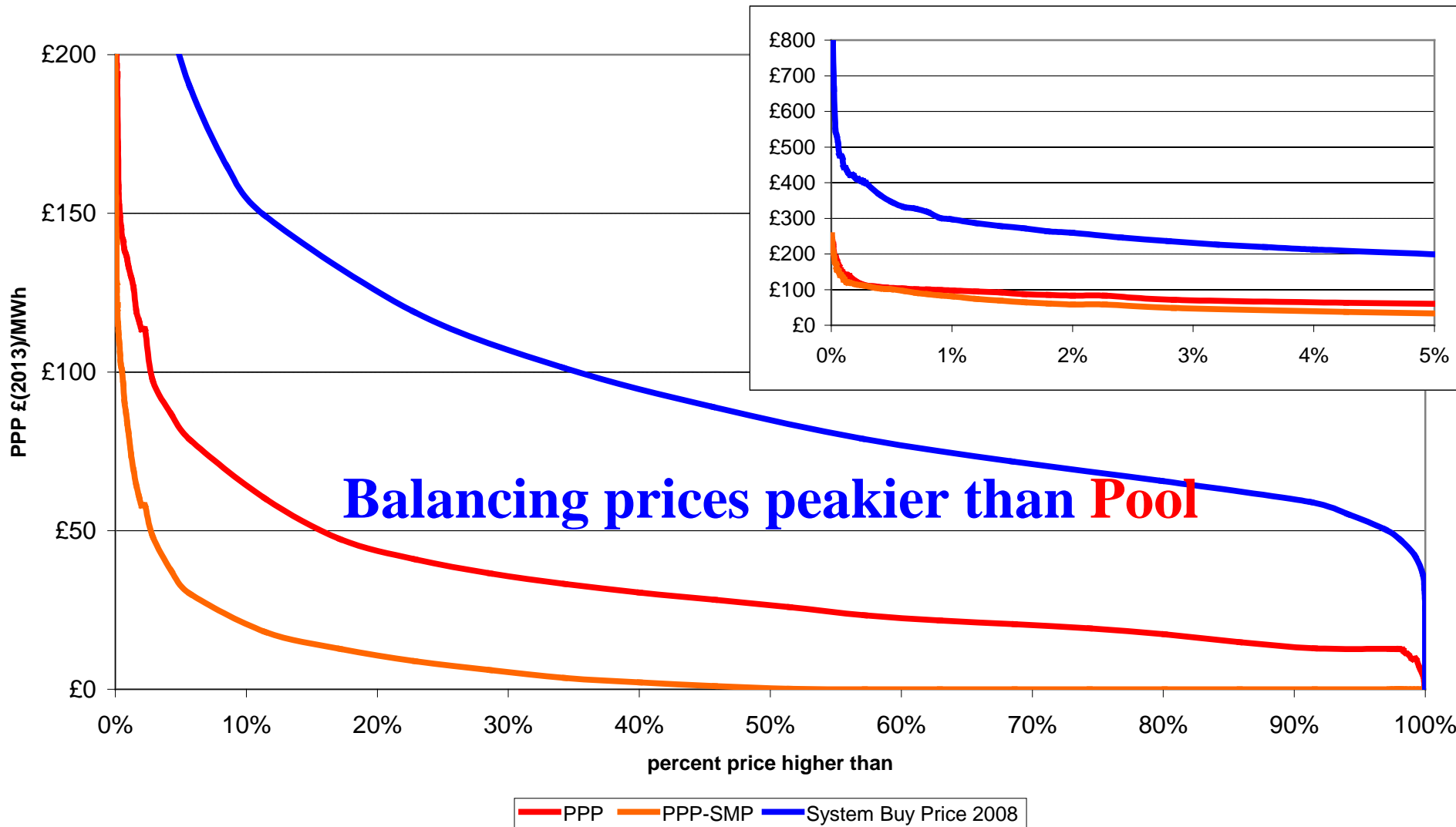
CP in the Pool - 50% revenue in 1.8% (158) hours

PPP-SMP 1998-9 at 2012 RPI prices



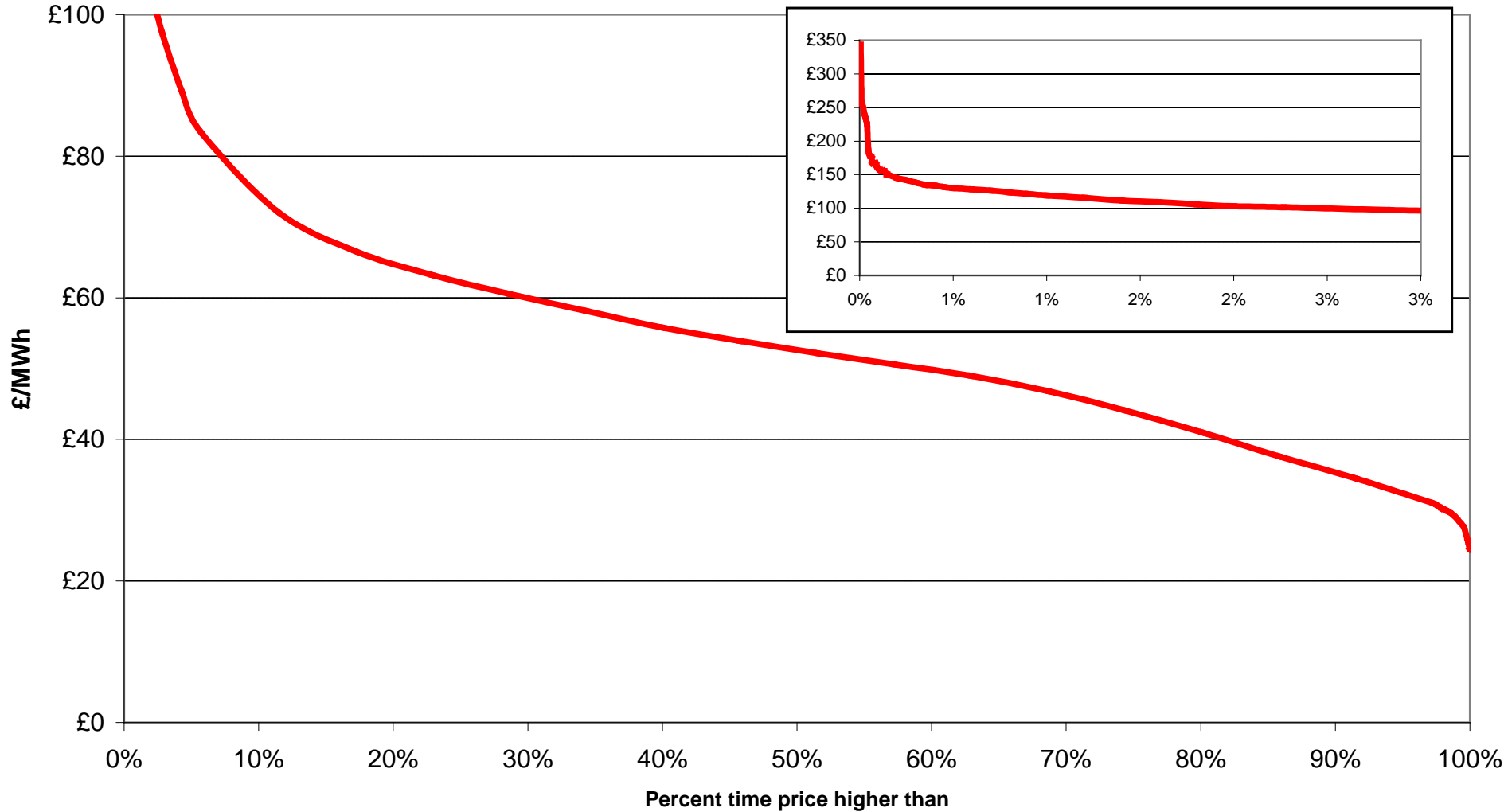
Pool prices 1998-9 and System Buy Price 2008

Price duration curves Pool 1998-99 and Balancing 2008 at 2013 CPI prices



Imbalance prices not adequately marginal?

Price duration of System Buy Price 2013-4

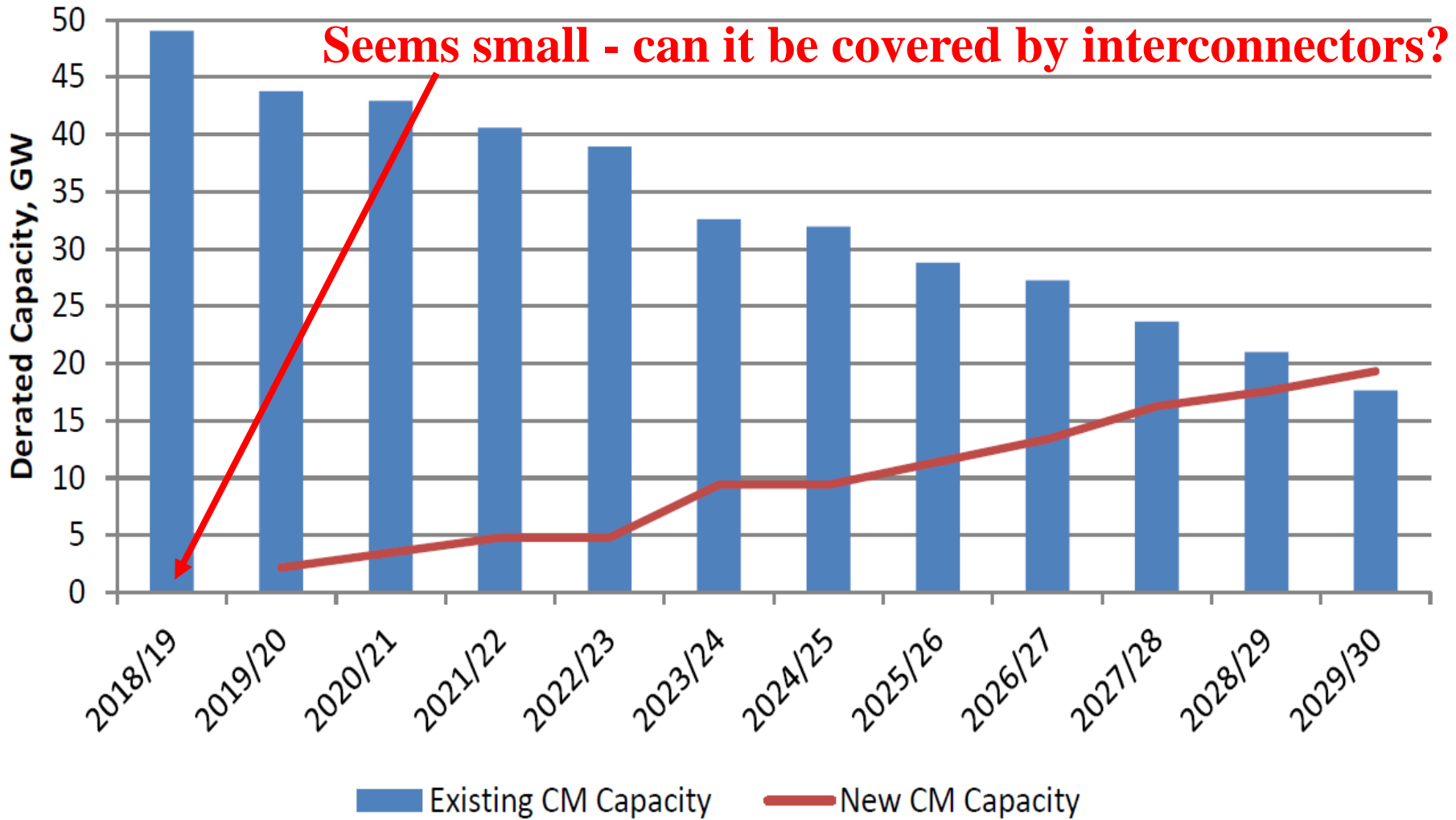


- Ofgem conducts **Significant Code Review** of BM
- Proposes:
 - single marginal price
 - load shedding bids at proxy Value of Lost Load
 - pVOLL = £3,000 rising to **£6,000/MWh** by 2018
 - DECC sets VOLL at **£17,000/MWh**
 - STOR bids in at $f(\text{pVOLL}, \text{LoLP})$

BM price has never hit even £3,000/MWh

Missing money: 3hrs*(£17,000-6,000)/MWh

Capacity to be replaced



Source: DECC IA

- **Pay-as-clear descending clock auction** in 2014 for delivery 2018/19
 - max energy price assumed £6/kWh
 - **LOLE = 3 hrs => VOLL = £17/kWh**
 - => **missing money = 3 hrs*(17-6)/kWh = £33/kW**
- new build gets 15 yr contract at auction price
 - existing plant: 1 yr contract unless major refurbish
 - must be **price taker** unless good cause, **entrants set price**
 - existing plant can **delay** until later auction (2017)
- DSR auctioned from 2016: 1 yr contracts

Illustrative auction demand curve

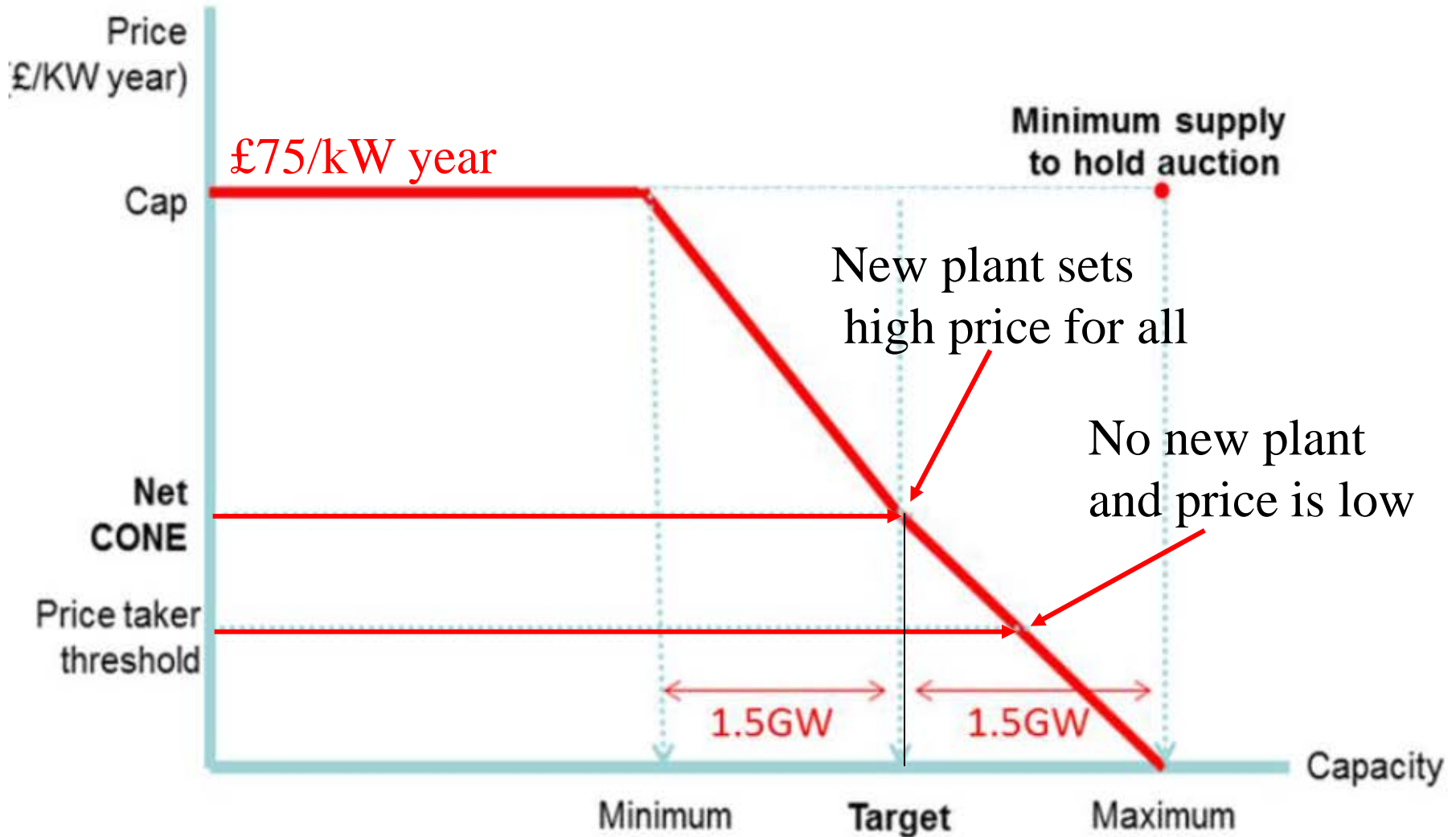
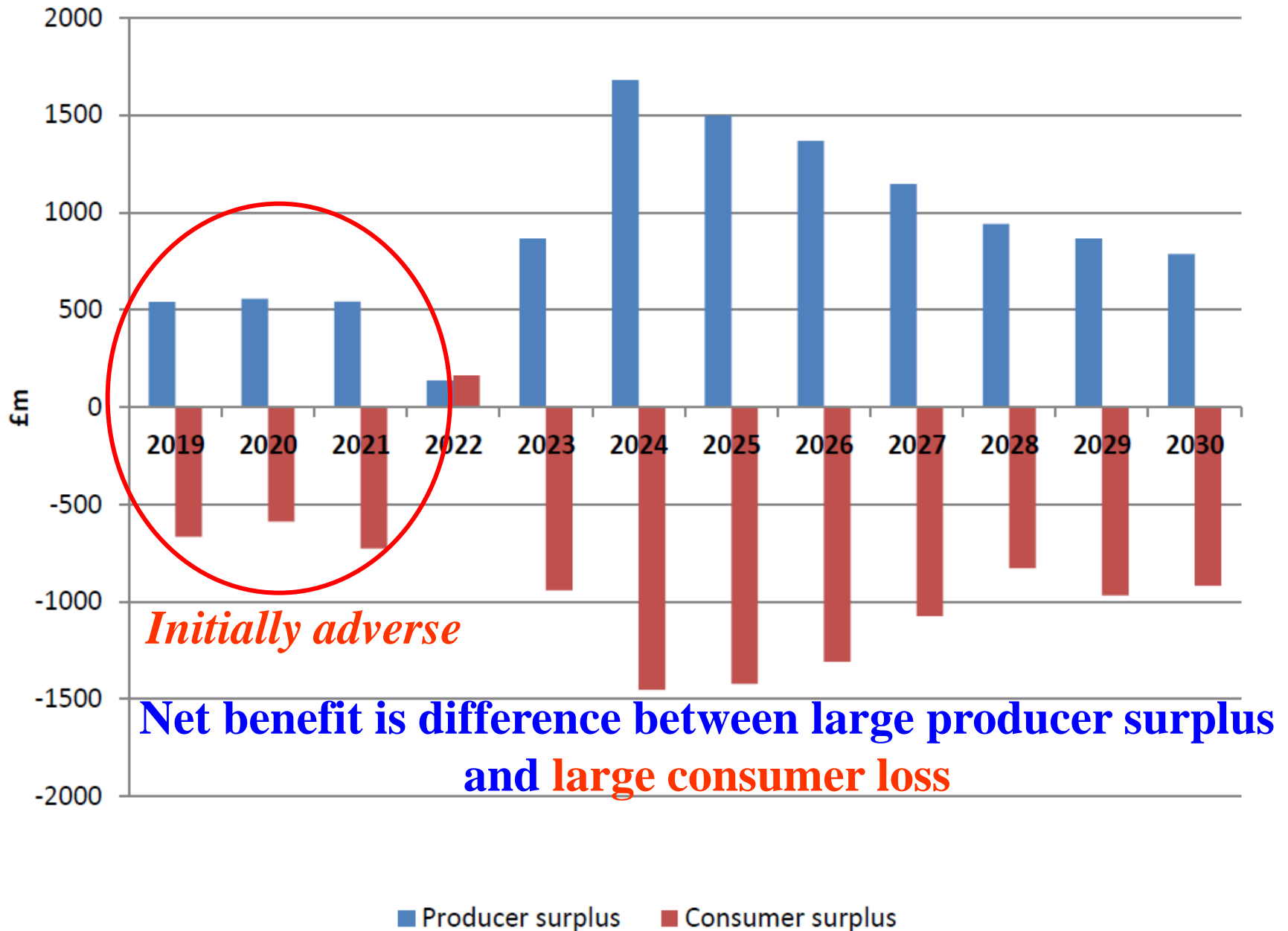


Figure 13: Change in producer and consumer surplus as a result of a Capacity Market



GB coupled to NWE 4/2/1

SEM not until 2016



SWE coupled to NWE 13/5/14



- Interconnectors increase security of supply
 - provided they are free to respond to scarcity
- ⇒ they should have a **positive derated capacity**
 - Poyry estimates **50-80%**
- Efficient pricing benefits trading country
 - if partner mis-prices they lose
- ⇒ **efficient pricing drives out inefficient pricing**
- But Euphemia imposes **€3,000/MWh cap**

- EU wants any capacity market to be EU-wide
- What contract can deliver capacity from abroad?
 - How does specific foreign plant **guarantee to export** to GB in stress hours?
 - PTR defaults to FTR on the day, but GB price may not signal true scarcity (and there is a price cap)
 - Would it not likely do so anyway without a CP?
- Why not have a contract with the SO for imports over the interconnector in stress hours?
 - Devolve to SO securing supply
 - **or SO auctions for capacity over IC?**

Investment in interconnectors

- The economics of investment look good anyway
 - and get better with more wind, PV, carbon price floor
- recognising contribution to security **increases value**
 - DC interconnectors are controllable
 - GB Interconnectors are logical suppliers of capacity
- problem: TO's cannot contract for generation
 - but SO (abroad) could run auction for capacity and access

=> rent collected by ICs

***EU open access to CP needs firm access to ICs
and penalties for non-delivery***

- Theory of scarcity pricing clear
 - leads to $CP = LoLP * (VoLL - SMC)$
 - energy-only markets could do this **in theory**
 - and hedge with reliability options
- main failures: **policy uncertainty and price caps**
 - and **lack of credible distant futures markets**
- Capacity markets can address these
 - **but** potentially large transfers from consumers

And need much higher Euphemia price cap



Appendix

Capacity Mechanisms: management of Interconnectors and cross-border effects

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BM	Balancing mechanism (or market)
CONE	Cost of new entry (net = net of revenue from selling power)
CP, CM	Capacity payment, capacity market
DSR	demand side response
EMR	(UK) Electricity Market Reform
F(P)TR	Financial (physical) transmission right
IC	Interconnector
LOLE	Loss of load expectation = \blacklozenge LoLP over year
LoLP	Loss of Load probability
PV	Photo voltaic
SEM	Single Electricity Market for Ireland
SMC(P)	System marginal cost (price)
SO	system operator
SRMC	short-run marginal cost
STOR	short-term operating reserve
TEM	Target Electricity Market
TO	transmission owner
VOLL	Value of Lost Load (£17,000/MWh in GB)

References

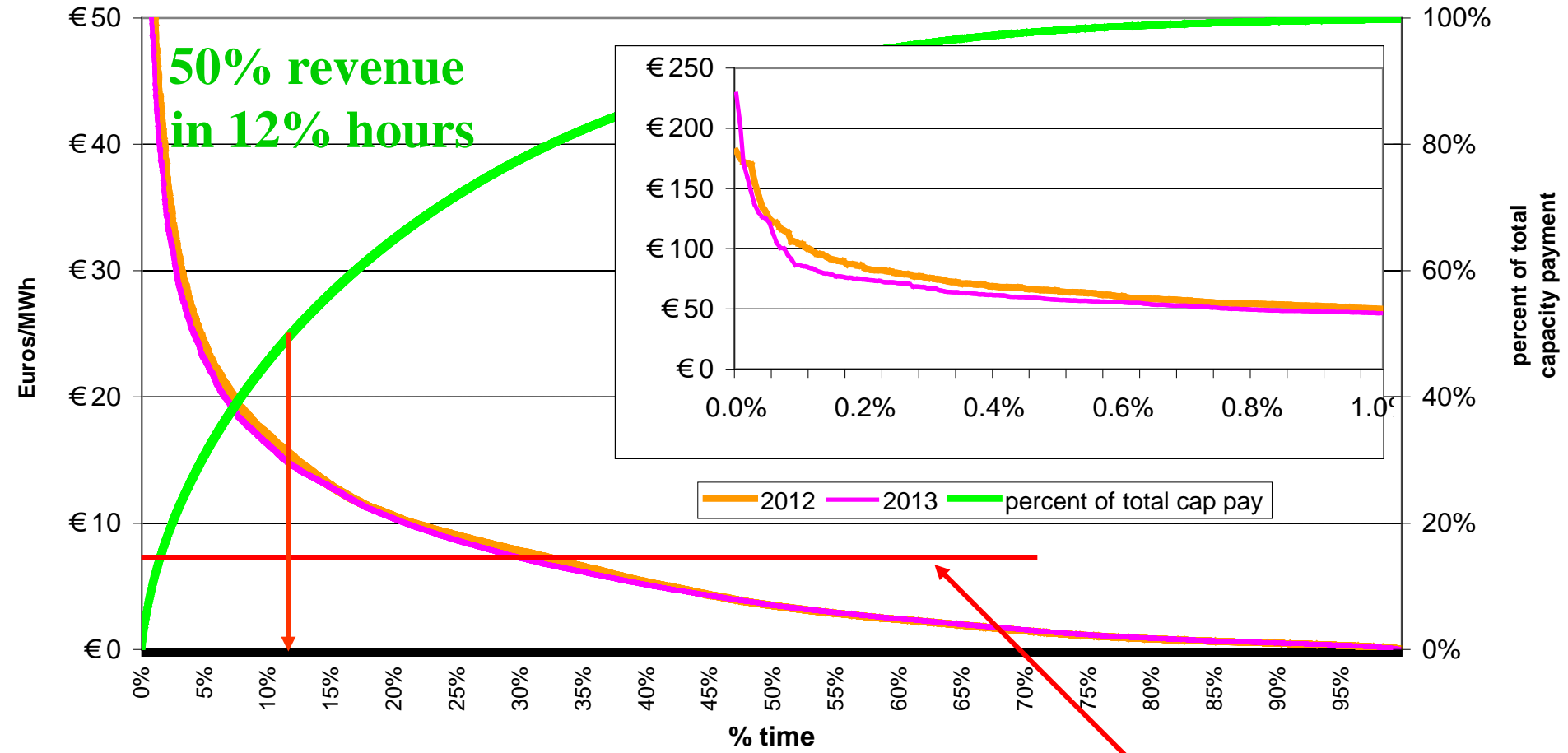
- DECC (2102) *Electricity Market Reform – Capacity Market Impact Assessment* at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/252743/Capacity_Market_Impact_Assessment_Oct_2013.pdf
- Poyry (2012) Poyry (2012) *Impact Of EMR On Interconnection: A report to DECC* at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/252744/Poyry_Report_on_Impact_of_CM_on_Interconnection.pdf

Capacity payments in Irish SEM

- Bidding Code of Practice requires generation to bid into Pool at SRMC
- => missing money => CP based on VoLL & LoLP
- generators get *ex post* system MC (SMC) + CP
 - VoLL scaled to deliver adequate payment for new entry, paid part on *ex ante LoLP*, part on *ex post*
 - stabilises revenue, reduces volatility
 - paid on imports, charged to exports

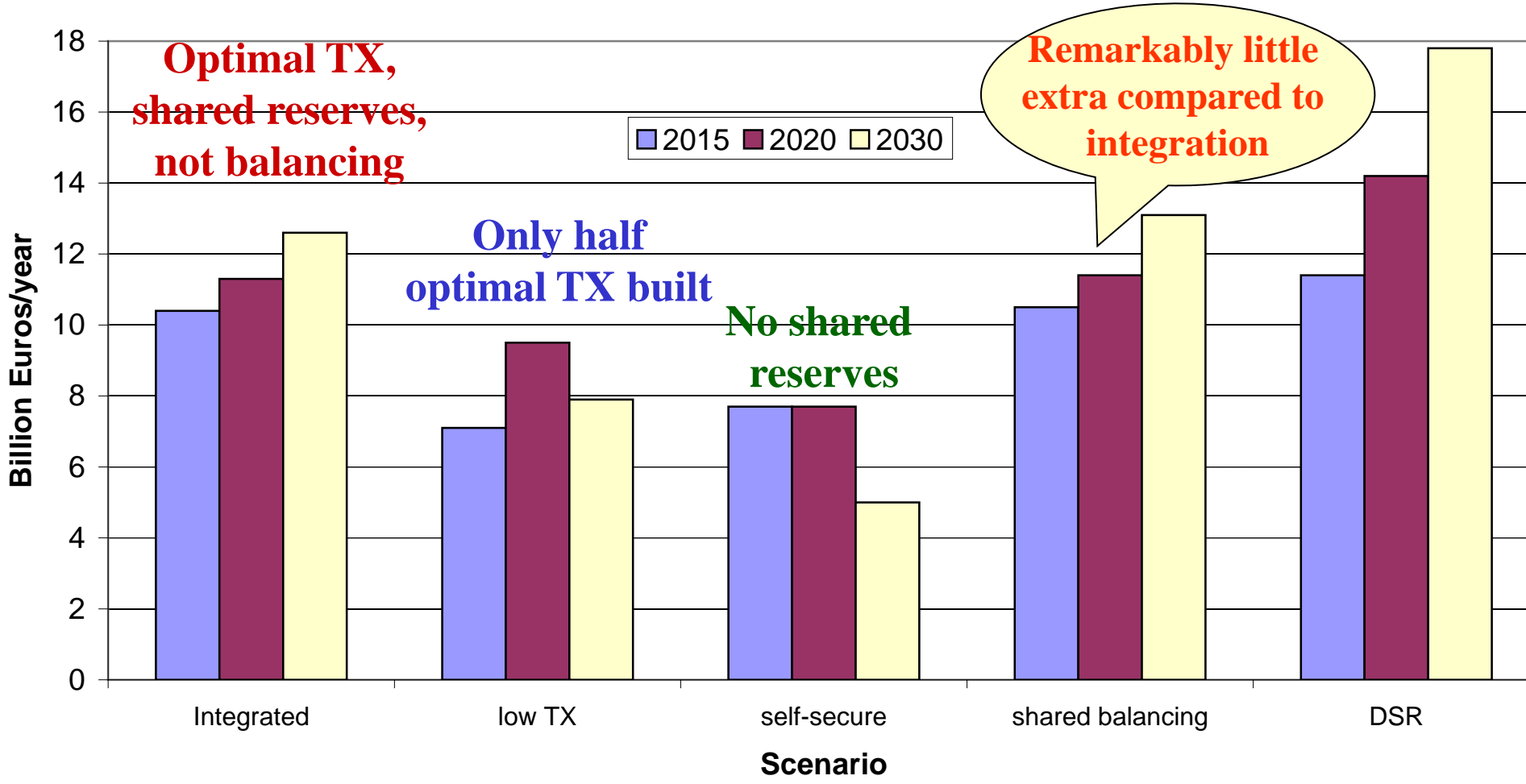
ex post pricing incompatible with TEM

SEM Capacity Payments 2012 and 2013



Average €/MWh

Benefits of market integration for EU 27+2 relative to base case



Base case: each country matches average production to consumption arbitrages over coupled IC's, no shared balancing or reserves

Source: DG ENER (2013)